CONTACT FOR SEMICONDUCTOR COMPONENTS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of Ser. No. 10/198,895 filed Jul. 18, 2002 U.S. Pat. No. 6,853,210, which is a division of Ser. No. 09/275,791 filed Mar. 25, 1999, U.S. Pat. No. 6,437,591 B1.

This application is related to Ser. No. 09/834,805 filed Apr. 12, 2001.

FIELD OF THE INVENTION

This invention relates generally to the manufacture and testing of semiconductor components. More particularly, this invention relates to an interconnect for electrically engaging bumped semiconductor components.

BACKGROUND OF THE INVENTION

Semiconductor components, such as bare dice, chip scale packages, BGA devices and wafers can include terminal contacts in the form of bumped contacts. This type of component is sometimes referred to as a "bumped" component (e.g., bumped die, bumped wafer).

The bumped contacts provide a high input/output capability for a component, and permit the component to be surface mounted, or alternately flip chip mounted, to a mating substrate, such as a printed circuit board (PCB). Typically, the bumped contacts comprise solder balls, which permits the components to be bonded to the mating substrate using a solder reflow process. For some components, such as chip scale packages and BGA devices, the bumped contacts can be arranged in a dense array, such as a ball grid array (BGA), or a fine ball grid array (FBGA).

For performing test procedures on bumped semiconductor components it is necessary to make temporary electrical connections with the bumped contacts. Different types of interconnects have been developed for making these electrical connections. For example, a wafer probe card is one type of interconnect that is used to test semiconductor wafers. Another type of interconnect, is contained within a carrier for temporarily packaging singulated components, such as bare dice and chip scale packages, for test and burn-in. The interconnects include contacts that make the electrical connections with bumped contacts.

One problem with making these temporary electrical connections is that the sizes of the bumped contacts on a component can vary. Some bumped contacts can have a larger diameter and a greater height than other bumped contacts on the same component. Also, if the interconnect is used to test different components the sizes of the bumped contacts can vary between components. The interconnect contacts may not be able to accommodate these size differences, making reliable electrical connections difficult to make. This problem is compounded because the interconnect contacts must penetrate native oxide layers on the bump contacts to make low resistance electrical connections.

Another problem with bumped contacts particularly solder balls, is that the contacts deform easily during handling and testing, especially at elevated temperatures. For performing test procedures, it may be difficult to make low resistance electrical connections with deformed contacts. Specifically, the contacts on the interconnect may not adequately engage and penetrate the surfaces of the bumped contacts unless large contact forces are employed. However, the large contact forces can also deform the bumped contacts. For subsequent bonding procedures, deformed contacts can make alignment and bonding of the component with a mating substrate more difficult. In addition, deformed contacts are a cosmetic problem that can adversely affect a users perception of a semiconductor component.

The present invention is directed to an interconnect for making temporary electrical connections with semiconductor components having bumped contacts. The interconnect includes contacts constructed to electrically engage the bumped contacts, and to accommodate variations in the size and planarity of the bumped contacts.

SUMMARY OF THE INVENTION

In accordance with the present invention, an improved interconnect for testing bumped semiconductor components, a method for fabricating the interconnect, and test systems incorporating the interconnect, are provided. The interconnect includes a substrate and a plurality of flexible contacts on the substrate for electrically engaging bumped contacts on a component under test. The interconnect also includes conductors formed on surfaces of the substrate, and conductive vias formed within the substrate, in electrical communication with the flexible contacts and with external contacts on the substrate.

The flexible contacts are formed on the substrate in a pattern, such as a dense grid array, that matches a pattern of the bumped contacts on the component. A first embodiment contact comprises a recess in the substrate, and a support member suspended on the recess for supporting a mating bumped contact on the component. A plurality of cantilevered leads support the support member, and are shaped to allow the support member to move in a z-direction into the recess during electrical engagement of the bumped contact. The cantilevered leads have a spiral or twisted configuration similar to impeller vanes on a centrifugal pump. As the support member and bumped contact are moved into the recess by an external biasing force, the cantilevered leads function as torque springs. In addition, the leads twist the support member relative to the bumped contact to facilitate penetration of oxide layers thereon.

A second embodiment flexible contact comprises a raised support member suspended over the substrate on spring segment leads. The spring segment leads have a spiral or twisted configuration that allows the support member to move towards the substrate, and to twist relative to the bumped contact.

The support member can comprise a ring with an opening having a peripheral edge for penetrating the bumped contact. Alternately, the support member can comprise a solid plate having one or more penetrating projections, for penetrating the bumped contact. In addition, the cantilevered leads, or the spring segment leads, can have a serpentine configuration to allow extension thereof during movement of the support member into the recess. Preferably, the support member comprises a non-bonding metal, or includes an outer layer that will not bond to the bumped contact. For example, for a bumped contact formed of solder, the support member can include a non-solder wettable outer layer.

The first embodiment contacts can be fabricated by forming recesses in the substrate, forming the conductors and conductive vias in the substrate, and then attaching a separate polymer film having the cantilevered leads thereon to the conductors. Alternately, the first embodiment contacts can be fabricated by forming recesses in the substrate,